Institute for Physical Research and Technology

ANNUAL REPORT 2001

IPRT WORKS for Iowa

IOWA STATE UNIVERSITY

The Institute for Physical Research and Technology is a network of research and technology-transfer centers and industrial-outreach programs at Iowa State University. IPRT also administers the Science Bound program.

RESEARCH CENTERS

Airworthiness Assurance Center of Excellence
Identifies and provides solutions for national aircraft-safety problems with a focus on inspection and maintenance issues.

Ames Laboratory of the U.S. Department of Energy
Seeks solutions to energy-related problems through the exploration of chemical, engineering, materials and mathematical sciences, and physics.

Center for Advanced Technology Development
Sets up contract research projects, helps Iowa businesses compete for federal funding and assists in technology commercialization and business start-ups.

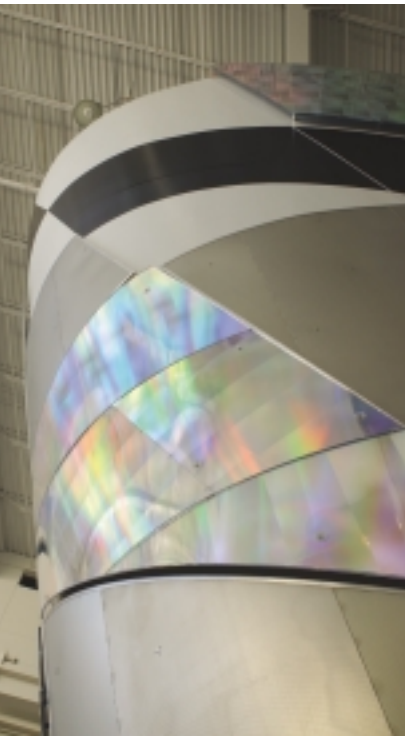
Center for Nondestructive Evaluation
Develops noninvasive methods and instruments for assessing the integrity of structures and materials.

Center for Physical and Computational Mathematics
Researches high-performance computing via cluster-computing and parallel-computing strategies.

Center for Sustainable Environmental Technologies
Develops and demonstrates renewable energy and chemical technologies and environmental technologies related to fossil fuels.

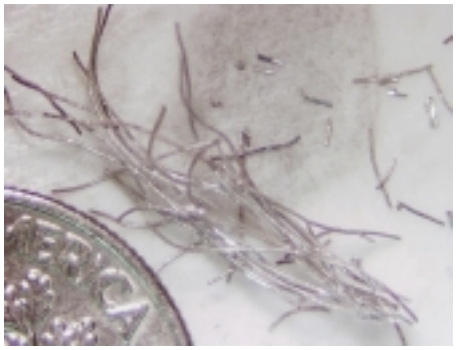
Materials Preparation Center
Prepares high-purity metals, alloys and compounds in single and polycrystalline forms for research and engineering uses.

Microanalytical Instrumentation Center
Develops innovative, small-scale analytical and bioanalytical instruments for emerging analyses.



Microelectronics Research Center
Develops advanced materials, devices and process technologies in the fields of semiconductors and photonics and provides educational laboratories in these technologies for both undergraduate and graduate students.

Virtual Reality Applications Center
Applies virtual reality technology to the challenges of science and engineering.



INDUSTRIAL OUTREACH PROGRAMS

Iowa Companies Assistance Program
Provides short-term technical assistance on manufacturing issues to Iowa companies. Helps solve materials-related and engineering questions and problems.

Iowa Demonstration Laboratory for Nondestructive Evaluation Applications
Assists Iowa businesses with nondestructive evaluation techniques and training.

Iowa Industrial Incentive Program
Establishes contract research and development at ISU through matching funds provided by the state of Iowa and Iowa businesses, industry, foundations and associations.

EDUCATIONAL PROGRAMS

Science Bound
Works to increase the number of underrepresented students who pursue science and technology careers.

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IPRT WORKS for Iowa

At the Institute for Physical Research and Technology, we are involved in many projects and initiatives but we never forget that one of our fundamental objectives is to facilitate economic growth and diversity in Iowa. Through economic development, research and education, IPRT works to make Iowa a better, safer and more prosperous place to live and work.

On the economic-development front, our assistance to Iowa companies and startups continues to reap large dividends. In this report, you can read how we helped Iowa companies save hundreds of thousands of dollars by improving product and process quality. You can learn how our Iowa partners have developed new products and created new jobs with our assistance. And you can see how we developed breakthrough technology and then helped turn that technology into the basis for a promising new startup right here in Iowa.

Research is central to IPRT's mission and provides the basis for the expertise we offer to all those with whom we work. Our centers conduct world-class research and work with organizations around the globe. In this report, you'll learn about just a few of the many research projects underway at IPRT, from building virtual reality training systems for the Iowa National Guard to developing technology to cleanly burn "dirty" Iowa coal for power generation worldwide.

Our education efforts start with eighth-grade students and extend through graduate school. In these pages, you can read how our Science Bound program is expanding on its promise to help underrepresented students of color pursue careers in math and science. You can also learn about a new graduate program in biorenewable resources being developed by one of our centers and how another of our centers gives electrical engineering students at Iowa State University a hands-on education in its labs.

At IPRT, we believe high-quality economic development, research and education are not separate thrusts but instead are complementary goals. Research grows into the basis for startup companies and new products at existing companies. Working with companies gives researchers an appreciation of today's business challenges. And our company-assistance efforts and research activities give ISU students real-world experience to augment their classroom learning and prepare them to work for Iowa companies.

In short, IPRT works for Iowa. If we can work for you, please give us a call.

Tom Barton
IPRT Director

Developing Iowa's Economy

Ames Laboratory's Ed Yeung invented a new chemical separation method named as the "Most Promising New Technology of 2001" by *R&D Magazine.* Shelley Coldiron is the CEO of CombiSep, Inc., a new Ames-based company formed to build and sell instruments based on the technology, which has wide potential in pharmaceutical and other industries. Helping to turn technology into successful start-ups is just one way IPRT builds Iowa's economy.

Separating from the Pack

IPRT spinoff targets multibillion dollar market with new chemical separation instrument.

Sprung from IPRT's Ames Laboratory with assistance from the institute's Center for Advanced Technology Development, CombiSep, Inc. is one of the most promising new companies, not just in Iowa but in the entire nation. Indeed, *R&D Magazine* bestowed its "most promising new technology" Editors' Choice award to Ed Yeung and CombiSep in October 2001.

The honor is in addition to an R&D 100 award given to Yeung's invention for being one of the top 100 products of technological significance marketed or licensed during the previous year. CombiSep, of Ames, Iowa, has won over $2 million in grants from federal agencies that will be used to expand its staff and further develop its technology.

CombiSep, Inc.'s MCE 2000 is a sophisticated new instrument for separating and measuring a variety of chemical compounds. With applications in pharmaceuticals, genetics and combinatonial chemistry, the IPRT-developed technology has thrust the Ames-based startup into national prominence.

Yeung, the developer of the technology, is director of Ames Laboratory's Chemical and Biological Sciences Program and a distinguished professor of chemistry at Iowa State University. Yeung's research in the technology, called multiplexed capillary electrophoresis using absorption detection, was funded by the U.S. Department of Energy.

Doing 96 Separations at Once

Yeung's instrument can rapidly detect and quantify chemical compounds in low concentrations or in small amounts. "This new method allows for universal detection of a majority of compounds, eliminating the need for expensive, cumbersome and potentially hazardous use of fluorescent tags," said Yeung.

Yeung co-founded CombiSep to quickly build commercial instruments based on this technology. Major pharmaceutical companies are already testing CombiSep's machine, the MCE 2000. Currently, the MCE 2000 can do 96 separations at a time, giving it an edge over traditional technologies that work on one sample at a time. "The instrument has already generated real interest in the user community," Yeung said. "Many of these companies are now negotiating to purchase an instrument."

From Idea to Market

To build prototypes of its sophisticated system in less than one year, CombiSep took advantage of the services and assistance provided by IPRT and other ISU organizations. "Contracting university resources has been valuable to us," said Shelley Coldiron, CEO of the Ames-based company.

CATD's Carey Novak, a technology transfer associate, helped launch CombiSep. "We're excited about the company because we have everything we need contained within this campus," he said, referring to services ranging from technology transfer to prototype design and fabrication. For its part, CATD helped the company get established and move the technology from the lab to the market. It also assisted by setting up a system that allows CombiSep's personnel to share information about technology, markets, competitors and other topics.

ISU's Center for Industrial Research and Service helped CombiSep design and build its prototypes. CIRAS contracted with the Ames Lab Engineering Services Group to fabricate precision components for the machine as well as to design and build its sophisticated electronics.

Handling an Innovation

An Iowa manufacturer develops the next generation of materials handling equipment with assistance from the Virtual Reality Applications Center.

Adding "power steering" to material handling manipulators can increase productivity and reduce back and other injuries. By lowering the force needed to start, stop and move heavy loads from over 100 pounds to just three, such a system allows operators of just about any gender, weight and build to perform material handling tasks.

Such a system is exactly what Positech, a Laurens, Iowa, maker of material handling equipment, has built with its new PowerTouch power assist system. PowerTouch is an optional attachment for Positech's Simple Air Manipulators, called SAMs, which use pneumatic power to maneuver loads of up to 900 pounds.

Designed with assistance from IPRT's Virtual Reality Applications Center, this equipment is used in factories to move heavy loads such as engine blocks. "While the concept of powered movement is not new, PowerTouch is currently the only product of its kind in the competitive manipulator market," said Peter Hong, president of Positech, a division of Columbus McKinnon Corp.

Sensing Force

The PowerTouch system consists of a computer-controlled servo system run by software. Through the use of amplifiers, motors and a processor, the system allows operators to smoothly rotate and move loads. The system senses the force applied by the operator to the hand controls.

Designing this sophisticated system required substantial expertise in human-machine interfaces, control systems, computer simulation and related technologies. So, Positech partnered with VRAC to develop the system, providing over $200,000 in research funding.

Greg Luecke, a VRAC associate and an associate professor of mechanical engineering at Iowa State University, and his team of graduate and undergraduate students created a computer model to predict the forces required to design the power-assist motors and actuators in PowerTouch. The researchers even brought in an operator from a Positech customer to help evaluate the system.

"Many ergonomic standards limit push/pull forces to less than 20 pounds. We were able to make a 900-pound payload feel like less than three pounds. That's quite an accomplishment and one that could significantly reduce lower-back and upper-shoulder injuries," Luecke said.

PowerTouch Partners

VRAC was an ideal partner. The center has world-renown expertise in human-machine interfaces and software as well as the equipment needed to simulate the product and build a prototype. "We worked closely with Positech, exchanging many visits. We have a good working relationship," Luecke said.

Positech's Hong agrees. "This was our first interaction with ISU and overall the project went very well," he said. "We learned a lot about the individual strengths and weaknesses of the university and Positech and how to better work together to maximize the strengths for achieving the outcome."

Positech has advertised the product nationally at trade shows and in industrial publications. "The product could result in many retrofits on machines previously considered ergonomically acceptable," Hong said, noting that ergonomic norms are shifting. "Likewise, the sale of new machines will increase as more and more customers require lower and lower effort forces for their workers."

The relationship between Positech and VRAC continues. Sean Mahrt, a VRAC graduate student involved in the project, is working for the company. "For someone coming out of a research environment, I believe his familiarity and ownership of the project has been a decided advantage," Hong said.

Positech, a Laurens-based maker of materials handling equipment, worked closely with VRAC researchers and students to develop an innovative new "power-steering" system for its line of pneumatic-powered lift systems.

An Evolving Relationship

The Iowa Demonstration Lab provides outside perspective to help Den Hartog assure quality.

A dynamic company, Den Hartog Industries, Inc., Hospers, Iowa, has expanded into several new areas since its founding as a family-owned retail/hardware store in 1967. One of these areas is rotationally molded parts, and, in fact, today Den Hartog manufactures 40,000 to 50,000 agricultural and industrial tanks annually. These tanks range in size from five gallons to 10,000 gallons and are shipped around the world.

There's no question that the company's success depends on its ability to produce reliable, leak-proof tanks. So, last spring Frank Sloup, quality assurance manager, turned to IPRT's Iowa Demonstration Laboratory as a resource to review existing tank inspection methods. IDL is an outreach program of the Center for Nondestructive Evaluation.

Getting an Outside Opinion

IDL scientist David Utrata met with Sloup and Robert Hardy, manager of engineering, to discuss the problem. Through observation of their current testing techniques, Utrata was able to make recommendations to their methodology in using the submerged dunk test to check for leaks. "One of the things that was significant to us was to have an outside opinion on what we were doing," Hardy explained. "Dave helped us highlight the leakage more effectively by enhancing how the bubbles appear both with lighting and with additives that are put in the solution," he said. "We are confident that we now are able to better detect problems before our products leave the factory," Sloup added.

This isn't where the story ends though. The relationship between Den Hartog and IDL is an evolving one, according to Utrata. "That's because they are comfortable enough to ask questions. Sometimes it's a question that we have to look into, and it becomes a feasibility study. Sometimes we know they are doing the right thing, and it becomes a matter of what could go wrong with that, and we help develop their technique," he explained.

Doing the Job Better

That was the case with using ultrasonic thickness gauges to test the thickness of parts using sound waves. Through research and presenting a variety of "what-if" situations, Utrata was able to demonstrate the importance of going through the calibration procedures for each new batch of plastic. "It wasn't a matter of them doing anything wrong, it was just that they could do it better. Now they are in a position to get uniform results and to think more deeply about how their production changes could affect their thickness measurements. In essence, they are really more educated consumers," Utrata said.

Providing information about NDE tools is another area where IDL was able to assist Den Hartog. Problems can occur, for example, where the two halves of rotationally molded parts are joined together or where fasteners are molded into the wall. Utrata demonstrated some visual testing techniques and tools for getting an inside view where evidence of flaws is often more pronounced. "He has saved us a lot of time in exploring the options," Sloup said.

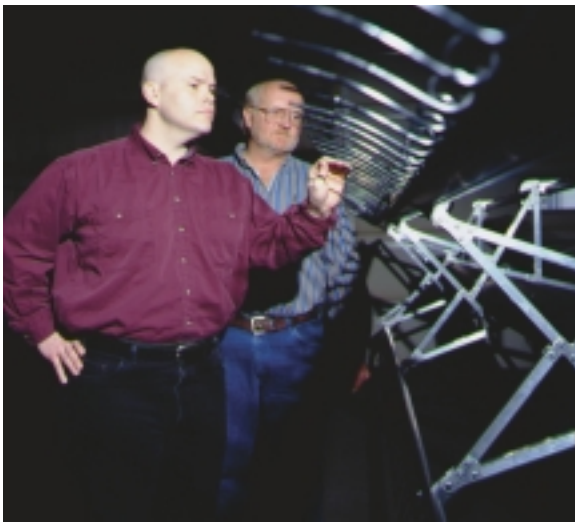
IDL's evolving relationship with Den Hartog has even more potential benefits for the company, according to Hardy. "It's good to have somebody from outside come in and give us a very honest perspective of what he sees or doesn't see. It's been wonderful to sit around and brainstorm about ways to solve things. That's how you come up with innovation as any progressive company knows," Hardy said.

To measure how thick the plastic tank is at a certain point, an inspector first sprays soapy water onto the sample surface. This is used as a couplant to allow ultrasound to travel from the transducer into the solid test piece. The digital readout on the ultrasonic thickness gauge then gives the precise measurement.

In Pursuit of Quality

IPRT helps an Iowa manufacturer keep and gain business by improving product quality.

Quality products are essential in today's competitive markets. And so it is that Universal Harvester Co. of Ames, Iowa and a leading manufacturer of pickup reels for combines, continually strives to improve its product quality. One reason is to ensure that existing customers are satisfied with their products; another is to meet the specifications demanded by potential new customers. IPRT's outreach centers provided invaluable assistance to help UHC on both of these fronts.



Universal Harvester's Murray Buchheit (right) studies the tines on one of the company's combine reels with ICAP's Paul Berge. IPRT has assisted the company on several projects to help it improve the quality of its products.

The Failure Sleuth

An essential component of combine reels is a spring-like tine, used by the hundreds on a typical reel to rake crops into the combine. When a UHC customer in Canada reported that tines on its reels were breaking, the company quickly moved to find out why. The problem wasn't readily apparent, so UHC called Paul Berge, a scientist with IPRT's Iowa Companies Assistance Program and an expert in understanding why metal components fail.

Berge started his detective work by looking at broken tines, but they didn't provide any clues since the condition of the fracture surface wasn't good. Next, Berge took some supposedly good tines, froze them with liquid nitrogen, and broke them. An examination of the resulting fracture surfaces with a scanning electron microscope showed what was happening. "If there was already a small crack in the tine, it would break easily at that location," said Berge.

More clues were revealed when Berge looked at unbroken tines from the Canadian reels. These tines, too, had small cracks. Using the SEM, Berge found road salt and rust in the cracks. The salt had probably gotten into the cracks during shipping. Finally, an examination of brand new tines also revealed small cracks.

From these clues, Berge made a conclusion with larger implications. "The road salt simply amplified the underlying problem," he said. "The crack was probably in most of the tines even before they were shipped." Berge deduced that the cracks were a result of a forming problem that exceeded the limits of the tine material.

Berge gave his analysis to UHC, which was able to work with its supplier to remedy the problem by increasing the radius of a bend in the tines and selecting a material that was easier to form. "We've had no trouble since," said Murray Buchheit, vice president of production at the company. Because UHC was able to find and fix the problem, it was able to preserve a customer worth about $750,000 in annual sales. "We were able to remedy the problem and preserve that portion of our business," Buchheit said.

The Deciding Factor

UHC also turned to IPRT when it needed help to justify construction of a costly powder-coating system. Buchheit first called Berge, who put him in touch with Dave Utrata of IPRT's Iowa Demonstration Laboratory. Berge knew that Utrata had done some work in powder coating.

Powder coating is an advanced method of applying a protective finish to products, resulting in a uniform, durable, high-quality and attractive finish. "We are in a highly competitive industry, and to be able to pursue growth opportunities we need to be capable of providing products and services that are in every way competitive, if not superior," said Buchheit. "A powder-coating system would be a big step in that direction."

IDL had the expertise and equipment to help UHC decide if powder coating was as superior as promised. "I did a corrosion study, the effect of which was to quantify how much better powder coating materials was than painting," said Utrata, an IDL scientist.

Armed with this information, UHC opted to build a powder-coating capability of its own. "IDL's assistance with this research was key to our decision-making process," said Buchheit. The company is now building an 8,000 square foot addition to do powder coating, which it plans to have up and running in early 2002. Operating and supporting this system will immediately create two jobs, according to Buchheit. More jobs will follow if this system results in business growth. What's more, the company has been able to eliminate hazardous waste that results from a traditional paint system.

Improving Images

The Center for Advanced Technology Development works with University of Iowa researchers to speed development of image-analysis software for an Iowa company.

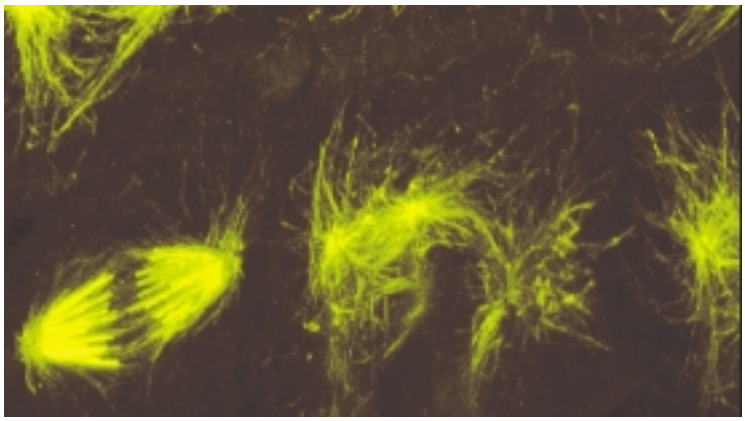
Giving researchers a better image is the aim of VayTek, Inc., a Fairfield, Iowa, developer of sophisticated software for three-dimensional image processing. The company's software takes input from a variety of sources — optical, seismic, ultrasound and radar — and turns it into 3-D images that literally provide researchers with better insights into data.

The company's flagship product, VoxBlast, is a general-purpose program used in medical, scientific, industrial, geoscience, surveillance and environmental laboratories. It has gained widespread market acceptance for its ease of use and low cost.

When the company needed to upgrade VoxBlast to add power and marketability, it did so more quickly thanks to assistance from IPRT's Center for Advanced Technology Development and researchers at the University of Iowa's ITS Research Technologies. "It probably would have taken us another year if we hadn't had help from CATD," said John Kesterson, VayTek president.

Sold Worldwide

VoxBlast software accepts stacks of two-dimensional images made by taking slices through an object with some type of scanning or microscopic technology. It then makes three-dimensional models with this data, adding shading, colors and otherwise enhancing the image. Once this model has been generated, researchers can use VoxBlast to interactively probe, measure, slice and dice the data in just about any way they need. They can even make movies to show, for instance, live cells.



VoxBlast software from VayTek, Inc. allows researchers of all types to create and interrogate three-dimensional models. The software was quickly upgraded with new features and functions thanks to assistance from CATD. This image is a 3-D reconstruction of chromosomes. About 40 images were captured with a confocal microscope from a speciman treated with fluorescent dye. The image shows the cells in various stages of cell division.

The software was originally developed by researchers at the University of Iowa and is still used in its medical school. Since 1993, VayTek has commercialized the software and sold it to researchers around the world. "It's been a successful story of technology transfer with the university," said Kesterson.

VayTek prides itself on serving the needs of its customers and realized that VoxBlast needed improvements to better meet the requirements of microscopy and medical-imaging applications. Through funding from CATD and VayTek, the University of Iowa researchers created new and redesigned functions for manipulating 3-D data. This technology is incorporated into the latest version of VoxBlast.

The new version has improved two-dimensional capabilities and the ability to generate data for use with other programs. It also takes full advantage of the latest versions of the Windows operating system for interactivity and ease of use. "We've always been able to maintain a cutting edge in our products," said Kesterson. The reasons, he explains, are its close work with the University of Iowa and by tapping services such as those provided by CATD.

All-Iowa Team

This project demonstrates how IPRT can collaborate with researchers and companies throughout Iowa, according to Mark Laurenzo, CATD interim director. "Even though we're part of IPRT and Iowa State University, we can and do work with researchers throughout the state," he said. "We go wherever we need to find the expertise. In this case, the University of Iowa clearly had the knowledge and expertise VayTek required."

VayTek first learned about CATD through a seminar it hosted on the Small Business Innovation Research, or SBIR, program. SBIR gives small businesses opportunities to propose innovative R&D projects that meet federal needs.

The Dock Doctors

IPRT helps an Iowa company build a better boat dock.

The innovative Connect-A-Dock Floating Dock system made by Schafer Systems, Inc. of Adair, Iowa, has many advantages. The product is a low-maintenance, modular floating dock system constructed of rugged polyethylene. As a result, it requires little maintenance and no painting or staining. The dock also does not rot or disintegrate like wooden docks, which often require costly repairs. Floating sections can be added, removed and arranged as needed to suit changing needs. And, since it floats, the Connect-A-Dock is well suited for areas in which water levels tend to fluctuate.

Schafer Systems, Inc. of Adair relied on IPRT to help evaluate its Connect-A-Dock Floating Dock system, creating a better product for its customers.

Those benefits are all for naught, however, if the dock and its components wither under the constant pounding of waves or fail to keep a boat at bay. So, the company turned to IPRT and Iowa State University to help better understand the performance of its dock system and its components. With this information, the company has been able to support warranty specifications and investigate improvements in the product.

Riding the Simulated Waves

One project involved testing the endurance of the entire dock system. Dock endurance testers, however, aren't something you can just buy, so Schafer came to ISU to build what came to be known as the Connect-A-Dock Wave Simulator. The simulator is a test rig placed in a large water tank that simulates wave motion by random mechanical oscillation of connected dock components.

The system was built by ISU's Center for Industrial Research and Service, with funding from IPRT's Center for Advanced Technology Development and its Iowa Industrial Incentive Program. IPRT's Ames Laboratory also helped fabricate the test system. The initial testing was done in a 19-foot diameter water tank on the ISU campus.

Once testing procedures had been validated and documented, the test unit was dismantled and moved to Schafer's facility. Schafer now uses this test fixture on a regular basis. "The cost-sharing funds provided by CATD under the Iowa Industrial Incentive Program enabled us to improve our design integrity and our time-to-market cycle significantly," said Ryan Gruhn, vice president of engineering and product development at Schafer.

Holding it all Together

The wave simulator was only one effort to help Schafer improve its product. IPRT's Iowa Demonstration Laboratory is also assisting the company with several mechanical-testing projects and salt-fog corrosion.

One project evaluated the strength of fasteners that hold some smaller dock components together. The IDL used its hydraulic test unit to pull the component while monitoring the load. Another IDL project evaluated the oxidation resistance of bolts and hardware to test the corrosion resistance of the parts under adverse conditions. This test gave Schafer confidence in the saltwater weathering of the fasteners and hardware used in the dock, according to Gruhn.

A recently completed effort evaluated the strength of cleats used to tie boats to the dock. Boat operators use a variety of rope attachment methods when tying to a cleat, and some put more stress on the cleat than average. Also, taller boats pull generally in a vertical direction, while shorter boats may pull directly horizontal. The tests account for these and other variables such as maximum wave action. The data has been provided to Schafer engineers.

The Stronger, the Better

The Iowa Companies Assistance Program helps an Iowa manufacturer of pipeline cleaners exceed its customer's specifications.

Pipeline Cleaners Inc. of Ft. Madison, Iowa, is about as experienced as anyone in the art and science of cleaning pipelines for oil, gas and other materials. Indeed, the company has been making specialized equipment for the task for over 100 years.

Still, when the company was working to expand its product line with a new cleaning brush, it turned to IPRT's Iowa Companies Assistance Program for help. With this assistance, Pipeline Cleaners was able to work out the problems of making a new type of brush that went into production in early 2001. The company is manufacturing thousands of the brushes every week with the aid of two full-time production workers, according to Marvin Harryman, vice-president at Pipeline Cleaners. Harryman, president Terry Van Aken, and other investors recently bought the Ft. Madison plant from BJ Services.

Pipeline Cleaners Inc. of Ft. Madison manufactures these steel brushes for use in pipeline-cleaning equipment. The company received assistance from ICAP to ensure that the brushes exceeded customer specifications.

Calling in the Solder Experts

Pipeline Cleaners' "Pitmaster" brush is about three inches long and about as big around as a finger. To make these brushes, hundreds of short wire bristles are soldered into a steel cap. A large number of these brushes — sometimes more than 1,000 — are used by Pipeline Cleaners' customer to make "pigs" that "grunt" their way through pipes to clean them.

The company, however, needed to ensure that the strength of the soldered joints met its customer's specifications before it started manufacturing brushes by the thousands. An Iowa Manufacturing Extension Partnership agent worked with Pipeline Cleaners and IPRT to do just that.

IPRT's ICAP and Ames Laboratory are experts in solder and soldering procedures. ICAP also has vast experience in testing the strength of materials and components. In the case of Pipeline Cleaners, Paul Berge, an ICAP scientist, worked the problem on both of these fronts. First, Berge tested the strength of the initial joints. The joints were weaker than desired, so Berge worked with Charlie Burg of the Ames Laboratory's Engineering Services Group to create a soldering procedure that would result in stronger joints. This information was then passed along to engineers at Pipeline Cleaners.

The team also needed to ensure that tests were valid. The tests were first done by soldering another cap on the open end of the brush so that the test equipment had a way of gripping the brush. "There was concern that this second soldering procedure was weakening the first joint," said Berge. So, Berge and Burg developed a way to fuse the bristle ends together, allowing the test equipment to grab the brush. This method provided confidence that the test results were indicative of the actual strength of the soldered joint.

Very Well Pleased

Over the course of the project, ICAP continued to test brushes as the company fine-tuned its process. The effort was an immense help to Pipeline Cleaners. "We are very well pleased with ICAP's service and recommend any business that is having trouble accomplishing a goal to at least check with IPRT's team of experts," said Harryman. "It is amazing how well a project can come together when the right knowledge is applied to the problem." He said that with the help of ICAP, the company was able to surpass its customer's specifications by almost twice.

Performing Leading-Edge Research

Adrian Sannier of IPRT's Virtual Reality Applications Center is equipped to enter the world of virtual reality. He's standing outside the center's C6 virtual reality theater, one of only a handful of six-sided VR facilities in the world. Sannier is leading a major project to research sophisticated new VR training systems for the Iowa National Guard. World-class research backed by world-class facilities is a hallmark of IPRT.

Training Troops
with Virtual Reality

The Virtual Reality Applications Center works with the Iowa National Guard to create a simulation system for training guard troops.

Soldiers may one day be given memories of places they've never been by undergoing training in a virtual reality system. That's one goal of research underway at IPRT's Virtual Reality Applications Center in cooperation with the Iowa National Guard and its Iowa Technology Center unit. The effort will provide Iowa Guard personnel with comprehensive and flexible training simulations.

"We'll be putting soldiers in the middle of simulated missions, giving them valuable first-hand experience without putting them in harm's way," said Adrian Sannier, associate director of VRAC and a professor in ISU's Industrial and Manufacturing Systems Engineering Department. VRAC specializes in "immersive" virtual reality, where users are surrounded by images and sound to make the experience seem as realistic as possible.

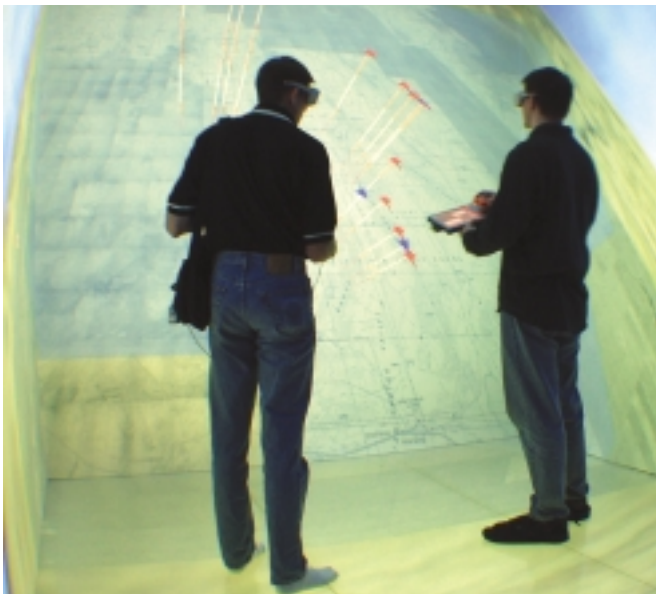
Leading in Digital Technology

"Iowa is poised to become a leader in applying telecommunications and information technology to mission training," said Brig. Gen. Joseph E. Lucas, director of the Iowa Technology Center, the Iowa National Guard activity sponsoring the project. "The ITC, Iowa National Guard, and ISU's VRAC form a world-class team in this emerging and important area," he stated. "Digital technology will play a major role in keeping the military of the future ready, and Iowa will be at the forefront."

The Iowa Technology Center, which received $23 million in initial funding from the Army National Guard, is expected to spur further high-tech development in Iowa. "I believe this is another stimulus to the kind of economic development Iowa needs to meet the challenges of the future," Lucas said.

VRAC will lend its virtual reality experience, expertise and facilities to the project, according to Joseph Gilbert, associate director of IPRT. "VRAC is the perfect partner in this project," Gilbert said. The center received $1.2 million of the $23 million for its part in the project's first phase. It also puts VRAC in position for future defense-related research, according to Gilbert. "The U.S. Department of Defense is watching this project very closely," he said.

Command and control is another area that will be explored, using virtual immersion to help clear the confusion that can accompany complex operations. Researchers will build synthetic theaters in which massive amounts of data that



This scene is from a simulation being created by VRAC to train Iowa National Guard pilots (the "sticks" under the aircraft show their altitudes). Such simulations can be run in facilities such as VRAC's C6 virtual theater, which projects images on all six walls of a small room to give users a realistic, 3-D experience not possible with traditional training methods and systems.

characterize modern engagements — from ground- and air-unit placements, to radar and satellite inputs, to information from numerous other sensors — are synthesized and displayed real-time in a 3-D virtual environment. Theater commanders will view this virtual scene from any perspective, including the adversary's, according to VRAC's Sannier. They will also "drill down" to any level of detail necessary. "We can give commanders a clearer picture, resulting in better situational awareness," Sannier said.

Learning about Computers and Humans

The project also serves as an initiator for VRAC's exploration of next-generation human-to-computer interfaces. "At VRAC, we believe the computer interfaces of the future will be immersive," Sannier said. "This research helps us understand how people can perform complex tasks more effectively using computer-generated immersive worlds." Indeed, much of the fundamental technology developed for this project has potential to benefit any VR application, according to Sannier.

ISU students — some 20 at any given time — will also benefit from the research. "These students will be exposed not only to the research process but will be instrumental in basic research on a variety of problems, from computer networking and real-time simulation to computer graphics and human-computer interfaces," Sannier said.

Hot Filter Leads to Clean Power

Ames Laboratory develops a metallic filter that holds the key to clean-burning, coal-fired power generation.

Iver Anderson thinks the solution to the rolling power blackouts in California may lie under the rolling black soil of Iowa's farm country. "Iowa is sitting on top of huge deposits of coal," said Anderson, senior metallurgist at IPRT's Ames Laboratory. "The problem is that it's high-sulfur, dirty coal."

That's why trainloads of cleaner-burning western coal pass by every day on the Union Pacific's east-west line, just a couple blocks away from Anderson's lab in the Metals Development building. As those trains rumble past, the Ames Lab researcher is closing in on a new material to filter the nasty ashes and dust that result from burning "dirty" coal. "The technology to burn dirty coal cleanly has existed for some time," Anderson said. "Demonstration plants have proven that highly efficient, low-emission power plant concepts are possible. The high pressure and high temperature burn off most of the pollutants, even those in the exhaust gases."

The flue gases, however, contain fine particles of fly ash that are high in sulfides, chlorides and sodium compounds. These particles pose an abrasive and corrosive threat to the turbines that drive a power plant's generators, as well as to air quality. To prevent these particles from reaching the power plant's turbine blades (and the atmosphere), the hot gas is passed through banks of cylindrical "candle" filters. Open on the bottom end, these 3-inch diameter filter tubes are about four feet long and currently made out of a ceramic material that can trap particles as small as one micron.

Looking for Superalloys

"The ceramic filters do a good job of standing up to the heat and the nasty oxidizing-sulfidizing environment created by the gases," Anderson said, "but ceramics can crack easily and if even a single candle filter breaks, the filtration ability of the whole bank is lost. You want a filter assembly that is rugged enough and has a long enough life that you can essentially forget about it," Anderson explained. "It's the last big hurdle to seeing this technology take off."

To find those properties, Anderson's research team looked at high strength "superalloys" developed for the aerospace industry that can withstand high temperatures. Using a process called tap-densified loose powder sintering, the metal is turned into thin, permeable sheets. High-purity molten superalloy is passed through a nozzle, where a high-pressure jet of nitrogen gas breaks up the stream of liquid metal into powder-fine particles. The metal powder is spread in a thin layer on a shallow "cookie sheet" and baked in a vacuum furnace. This sintering process bonds the powder particles together, forming strong, smooth joints between the particles, but leaving air gaps as well.

The filter material can be bent and formed, and methods for welding it are being tested. The next phase will be to try out the filters in one of the test power plants. "I'm a conservationist at heart," Anderson said, "but of the resources available, we have a much greater reserve of coal than anything else, even here in Iowa. Making it possible to burn dirty coal cleanly would provide us the stop-gap that we need until we can develop the ultraclean hydrogen conversion (fuel-cell based) power plants or use completely renewable resources."

Ames Laboratory senior metallurgist Iver Anderson holds a high-pressure nozzle used to turn molten alloy into the ultrafine powder seen in the jar. That powder is then heated in a sintering furnace to form a porous metal filter material that may make it possible to burn "dirty" coal more cleanly.

Detecting Defects

Nuclear waste storage tanks are a focus of research in the Center for Nondestructive Evaluation.

Scientists at IPRT's Center for Nondestructive Evaluation are part of a national effort to evaluate the structural integrity of nuclear waste storage tanks. "The Department of Energy has about 250 underground tanks that store millions of gallons of nuclear wastes," said R. Bruce Thompson, CNDE director. "Our role is to utilize our expertise in NDE to support the process of inspecting the tanks."

Located at five DOE sites throughout the country, the tanks were built between the 1940s and 1980s. Some have already exceeded their original design life, and, as they age, concern about leaks increases. While work is underway to convert the wastes into a form acceptable for permanent storage, many of the tanks will be used for at least another 20 years, making assessment of their structural integrity critical.

Ames Laboratory's Nondestructive Evaluation Program is coordinating and implementing the project funded under joint sponsorship of the Tanks Focus Area and the Characterization, Monitoring, and Sensor Technology Crosscutting Program, U.S. DOE, to develop new and improved technologies for tank integrity assessment. Four CNDE technical assistance projects are underway as part of the effort.

Ready for In-tank Demonstration

The first project, headed by CNDE scientist David Rehbein, focuses on corrosion detection. It uses a technique, developed by CNDE working in collaboration with Sonic Sensors of EMAT Ultrasonic, Inc., which makes use of guided ultrasonic waves propagating along the tank walls (sometimes known as Lamb waves) to perform a rapid screening of the tank walls for corrosion. Successfully demonstrated in a manual mode on mock-ups, the next steps are to develop and test a complete system and do an in-tank deployment on a tank that has gone through a detailed inspection. "We want to confirm that this technique will raise a flag in the areas in which significant issues exist, as detected by other techniques," Thompson explained. Positive results would mean this technique would serve as a screening test, and the more detailed inspection, which can take up to three weeks per tank, would only be used when the screening test indicated the need.

Developing Theoretical Tools

The second project is to obtain data from areas of the tanks subject to relatively high stresses and, hence, of greatest concern from the perspective of sensitivity to defects, but very hard to access; for example, where the sides and bottoms of the steel inner wall are joined in double-shell tanks. "The idea is to excite some kind of ultrasonic wave in the annular region where there is physical access and have it propagate around the bottom and find defects, plus get information about how large the defects are. It's well established how the particular technique under consideration works on a flat plane, so our scientist, Ron Roberts, is developing some theoretical tools to analyze the wave propagation phenomena as applied to curved geometry," Thompson said. Roberts is working in collaboration with scientists at the Department of Energy's Pacific Northwest National Laboratory.

Checking Out Support Structures

The process of emptying the older single-shell tanks has led to a third project. There is concern about whether the concrete structure that surrounds the tanks and provides structural support can withstand the load from the heavy equipment used to retrieve the wastes. Sam Wormley, CNDE researcher, and Steve Russell, ISU professor of electrical and computer engineering, are investigating whether spread-spectrum ultrasonic techniques, previously used to detect very small changes in other concrete structures, can be applied to the storage tanks with their unique characteristic of being underground with limited access.

Identifying Steel Alloys

Determining the alloy content of the steel used to construct the tanks is the focus of the final project. CNDE scientist Marcus Johnson has been working on a technique to characterize, based on magnetic properties, the steel alloys that were used in the tanks. This is significant, according to Thompson, because the metal alloy used determines the fracture toughness and, therefore, affects the levels of load that different crack sizes can tolerate.

David Rehbein, CNDE scientist, developed a technique for inspecting nuclear storage tanks using equipment built by Sonic Sensors of EMAT Ultrasonics, Inc. This EMAT (electromagnetic acoustic transducer) inspection system is faster than the conventional ultrasonic inspection system and does not require extensive (and expensive) surface preparation in order to perform the inspection.

Out-of-this-world Research

Microanalytical Instrumentation Center researchers take zero-gravity flight to study space-bound technology that may have applications on earth.

Human exploration of space is limited only by the imagination — and a supply of potable drinking water. A team of scientists from IPRT's Microanalytical Instrumentation Center and the NASA Johnson Space Center are working on the latter by developing novel instrumentation for monitoring the quality of spacecraft drinking water. The first test of one such technology came when the researchers flew on NASA's KC-135 reduced-gravity aircraft.

This research is important as spacecraft designers look to meet the demands of longer flights. Indeed, they are working toward the day when all waste streams will be recycled to make potable water. Moreover, the rugged, miniaturized instrumentation required for this effort has earth-bound applications in environmental monitoring and other areas. "There's a huge overlap between space- and earth-based needs," said Marc Porter, MIC director and an Iowa State University chemistry professor. The three-year project is funded by a grant of over $300,000 a year from NASA.

MIC director Marc Porter, left, experiences near zero gravity aboard NASA's KC-135 aircraft as his research team runs a prototype water quality monitor through its paces. Someday, the MIC technology may be used on long space flights to ensure a supply of potable water and on earth for environmental monitoring.

Flying the Weightless Wonder

MIC's prototype system was designed to sense chemicals used in treating water to make it fit for human consumption. According to MIC team members Matteo Arena and James Fritz, the instrument is essentially a small analysis system that can detect levels of iodine or silver — two chemicals used to treat water in spacecraft. This first test showed that the basic technology works in zero gravity.

The near zero-gravity environment was provided by NASA's KC-135, also known as the "Weightless Wonder," a four-engine turbojet used to fly a series of parabolic arcs to investigate the effects of zero gravity. MIC's test flights lasted approximately two hours, traversing some 40 parabolas that each produced about 25 seconds of near zero-gravity environment.

Miniaturization is Key

The main goal of the research is to develop lightweight, miniaturized systems that solve a number of the problems associated with monitoring and controlling water quality on manned spacecraft. Another objective of the research is to improve the archiving of water samples to be returned to earth for further analyses. Miniaturization, one of MIC's specialties, is the key to meeting all of these requirements, according to Porter.

This project is one of only 14 projects awarded grants under a NASA effort to advance human support technologies. Porter said MIC received its grant in part because of its expertise in diverse areas such as analytical chemistry, electrochemical sensing and microelectronics.

In addition to Porter, MIC researchers that flew on the KC-135 were Arena, a visiting scientist, and Duane Weisshaar, a visiting professor. The MIC's Fritz is an ISU distinguished professor emeritus of chemistry. They are working with scientists in the Space Water Quality group at NASA Johnson Space Center in Houston and at Wyle Laboratories, the NASA contractor for water-quality projects. Wyle researchers who also flew on the test flight were Paul Mudgett, Jeff Rutz and Mickie Benoit.

Scaling Up

DOE grant will allow researchers in the Center for Physical and Computational Mathematics to improve software for high-performance computing systems.

High-performance computing systems are capable of doing trillions of calculations per second. Amazing as that may seem, these systems are poised to do even more — but only if the software can keep up with today's extraordinary progress in computing technology.

Now researchers in the IPRT Center for Physical and Computational Mathematics will be able to concentrate on improving software for terascale computers thanks to the U.S. Department of Energy's Scientific Discovery through Advanced Computing initiative. A SciDAC award of approximately $1.35 million to the DOE's Ames Laboratory over a three-year period will make it possible for computational scientists from CPCM and Ames Lab's Scalable Computing Lab to carry out two projects designed to help achieve SciDAC goals.

Optimized for Tomorrow's Computers

"The Ames Lab SciDAC projects will focus on designing important new software that is optimized for tomorrow's advanced supercomputers," said Bruce Harmon, CPCM acting director and Ames Laboratory deputy director. "These supercomputers and the new software will be key tools for scientific discovery. The work helps keep Iowa State University at the forefront in high-performance computing for science and engineering."

Brett Bode makes use of the SCL's IBM 32-node parallel computer to investigate ways of improving the management of high-performance computing systems.

In one project, a team of CPCM and SCL researchers led by Mark Gordon, director of Ames Laboratory's Applied Mathematics and Computational Sciences Program, will be developing highly scalable computational chemistry simulation codes capable of predicting energy surfaces of very high accuracy in both ground and excited electronic states. (Scalable refers to the ability to halve the computational time by doubling the number of processors.) "Such advances in computational chemistry would tie together with advances in scalable computing — they really feed off of each other," said Gordon.

The SciDAC computational chemistry project includes co-principal investigators Klaus Ruedenberg, James Evans and Mike Schmidt. "We're all interested in developing very high levels of theory into scalable code that will allow scientists to do very accurate calculations on much larger chemical systems," said Gordon. "That means we'll be able to attack more complicated problems."

Managing Thousands of Processors

In the second SciDAC project, CPCM and SCL researchers will address the effective use and management of terascale computational resources. The project will also include six other DOE labs and the National Center for Supercomputing Applications. Although these facilities build and manage large-scale parallel systems, none of them has the tools to manage those systems effectively, said CPCM researcher Brett Bode. "Many of the servers currently operating were not designed with the scalability needed today," he noted. "They can handle requests from a dozen or two computer nodes, but when you start throwing hundreds of nodes at the same software on the same server, it really no longer has the ability to cope, which can lead to slowdowns and major problems."

Bode and the other collaborators on this SciDAC project will address the situation by creating a virtual Scalable Systems Software Integrated Software Infrastructure Center. The ISIC will develop an integrated suite of scalable system software components to ease the management of high-end computing systems with thousands of processors.

"By the time we're done with the full software package, we will be able to deliver computing cycles on high-performance parallel systems to application users on these systems much more effectively," said Bode. "And we believe this will enable the next generation of parallel computing systems."

Educating Tomorrow's Scientists and Engineers

Matt Welsh, a senior in electrical engineering from Manly, Iowa, is one of an increasing number of Iowa State University students who are gaining valuable hands-on experience in a laboratory course taught in IPRT's Microelectronics Research Center. Enriching science and technology education in Iowa is central to IPRT's mission, working hand-in-hand with our research and economic development efforts.

EDUCATION

CSET Develops Major in Biorenewable Resources

With the leadership of IPRT's Center for Sustainable Environmental Technologies and $375,000 funded over three years from the U.S. Department of Energy's Office of Industrial Technology, Iowa State University is developing a graduate major program in biorenewable resources. The program, which currently is in the curriculum-review process, will offer study in the use of plant- and crop-based resources in the production of such value-added products as liquid fuels, commodity chemicals, lubricants, plastics and building materials. It will be administered by CSET.

David Falkowski, graduate student in mechanical engineering, runs the fast pyrolysis pilot plant at BECON. The unit converts switchgrass, cornstover and other biomass into pyrolysis liquid suitable as fuel or as a source of chemicals.

Traditional academic disciplines are not well organized to train engineers and scientists for the biobased-products industry, according to Robert Brown, director of CSET and ISU professor of mechanical engineering and chemical engineering. In order for the industry to grow, key technologies, such as those to purify value-added products and to convert plant materials into simpler components, need to be developed.

"The research and development that will drive this industry draws from many disciplines like chemistry, microbiology, agronomy and engineering," Brown said. The new graduate major will consist of a 30-credit program of coursework, research and industrial interaction. "It is designed to help students develop a systems perspective of the biobased products industry with an appreciation of problems in plant sciences, production, conversion and utilization," he said.

Three new courses will be the foundation for the major. A lecture course will cover current and future applications, biological and chemical conversions, case studies, economics and environmental impact. A laboratory course will include experiments in milling, extrusion and biomaterials with students using the Center for Crops Utilization Research facilities. Academic researchers and scientists from companies such as Cargill, Archer Daniels Midland, Grain Processing Corporation, Dow Chemical and DuPont will discuss current topics in a seminar course.

In addition, technical electives will be selected from existing classes in molecular biology, chemistry, biochemistry, agricultural and biosystems engineering, food science, chemical engineering and other disciplines. Pending approval through the curriculum-review process, the seminar course will be first offered in Fall 2002 with other coursework scheduled to begin shortly afterward.

Lab Captures Student Interest

IPRT's Microelectronics Research Center is giving Iowa State University engineering and physical sciences students a real-life opportunity to make semiconductor electronic devices. In a laboratory-based course, students take a raw silicon wafer and convert it into working transistors and diodes, a path that requires learning over 15 different semiconductor process and testing sequences, according to Vikram Dalal, MRC director and ISU professor in electrical and computer engineering.

IPRT's MRC offers students, such as David Garcia, graduate student in electrical and computer engineering, the opportunity to make semiconductor electronic devices.

"The thrill on the face of students when they see their experimental devices work just the way they are supposed to is a joy to behold," he said. Matt Welsh, a senior in electrical engineering, is one of the many students excited by the opportunity. "In this lab we're not just wiring a circuit together, but actually making the transistors that go into the circuit," he explained.

Job opportunities in the semiconductor industry, word-of-mouth advertising by students, and an increasing number of ISU faculty with interests in electronic materials and devices have contributed to the lab's soaring popularity. In addition, it recently became a requirement in the Electronics Materials option within Materials Science and Engineering. The course is taught by professors Gary Tuttle, electrical and computer engineering, with help from professors Dalal, Robert Weber, ECpE, and Alan Constant, materials science and engineering.

Science Bound Expands Efforts

IPRT's Science Bound program, which aims to increase involvement of underrepresented students of color in science and math careers, continues to expand as it enters its second decade. The numbers tell the story. During the past academic year, Science Bound graduated three more students from Iowa State University. In the fall of 2001, 13 of 16 Science Bound high school seniors were accepted for enrollment at ISU, and 56 seventh graders were invited to join the approximately 150 students already in the program.

In partnership with Des Moines Public Schools, Science Bound provides science and math-related activities to complement the regular school curriculum. Students must maintain a 3.0 grade point average in addition to participating in Science Bound activities. Students who successfully complete the Science Bound program and pursue a technical degree receive a full-tuition scholarship to ISU. The effort is specifically designed to help students in grades 8-12 whose standardized test scores and/or teacher recommendations indicate ability to achieve in math and science, but whose grades may not reflect this ability.

Science Bound continues to grow and find ways to help underrepresented students further their math and science education:

• Science Bound is staying on top of Iowa's changing population make-up. The number of Hispanic students enrolled in the program more than doubled (29 to 61) from the 1995-96 to the 1999-2000 school years. Today, Hispanics make up almost one-third of the students in the program, which continues to expand its reach to African-Americans and American Indians as well.

Three students from Louisiana are attending ISU thanks in part to IPRT's PIPELINES program. Jasmyn Dyer, Sarai Arnold and Chimene Ibekwe were all top students in high school and considered attending some of the nation's foremost universities. "If it weren't for PIPELINES, I wouldn't have known that Iowa State existed," said Ibekwe. "It was this program that brought me here and kept me here."

• Science Bound is implementing new ways to further its participants' chances of success. The new "Learn and Earn" program provides intensive, four-week classes in algebra and language arts. Taught by ISU professors, this program gives high school freshmen a jump start in these critical topics.

• Science Bound students, teachers and undergraduates continue to have new resources and opportunities made possible by the Program to Increase the Pursuit of Education and Learning IN Engineering and Science, or PIPELINES. This effort, funded by NASA, is a collaboration between Southern University A&M in Baton Rouge, Louisiana, and ISU/Science Bound. The program has many facets, including student exchanges between Iowa and Louisiana, funding of students to conduct research at both Southern and ISU, and support of programs such as Science Bound's Learn and Earn effort.

In addition to funding from ISU and the Institute for Physical Research and Technology, Science Bound is made possible by industry sponsors.

Students Dive into Science Bowl

The Ames Laboratory/Iowa State University 2001 Science Bowl was a success, despite harsh winter weather on the last Saturday in January 2001. The event consists of teams of students from Iowa high schools in a fast-paced, daylong competition to answer a broad range of science and math questions.

Some 42 teams, each with up to five students, competed in the event. Faculty and staff members from Ames Laboratory, IPRT and ISU served as moderators, judges, timekeepers and scorekeepers. Ames High School won the 2001 edition of the competition, marking the school's fifth title. The team advanced to the U.S. Department of Energy National Science Bowl in Washington, D.C.

SCIENCE BOWL 2001

The event is one of more than 60 regional competitions held throughout the nation. First developed in 1991, the goal of Science Bowl competition is to encourage high school students to excel in science and math and to pursue careers in those fields.

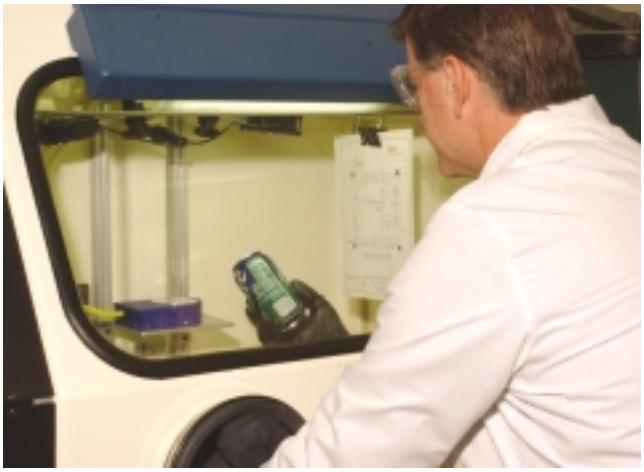
NEWS

IPRT's Forensics Effort Delivers

IPRT's forensics initiative continues to gather momentum. Fingerprinting equipment developed by IPRT in collaboration with the Iowa Division of Criminal Investigation has been delivered and evaluated and is now in regular use at the DCI's Criminalistics Laboratory. Also in 2001, IPRT and the Ames Laboratory hosted the second meeting of the Midwest Forensics Resource Center.

The fingerprinting equipment consists of two devices designed to improve the development of latent fingerprints on a variety of items, from plastic bags to rifles. One is a "glove-box" cabinet that allows fingerprint examiners to control humidity when developing prints, to observe the development process and to handle potential evidence while fingerprints are under development. The other device is a vacuum chamber that allows examiners to develop prints on surfaces that usually obstruct or even prevent fingerprint development.

Since taking delivery of the equipment, the DCI has run numerous tests to determine the optimal use of the devices. DCI criminalists and examiners are also preparing at least one scientific publication to inform others about their success using the new equipment. "This equipment allows our fingerprint examiners a lot more flexibility and the chance to be more successful in doing their job," said Carl Bessman, a criminalist with the DCI. "We have already used the equipment in actual cases."



Midwest Forensics Resource Center effort continues to grow and has already resulted in the design and construction of equipment such as this glove box to improve and speed the fingerprinting process.

The goal of the Midwest Forensics Resource Center is to serve as a central point for regional training, education and research in forensic science. This year's MFRC meeting, held in May 2001, reflected how much the effort to establish the center has grown. Attendees represented eight Midwestern state crime labs; three universities; the Federal Bureau of Investigation; the National Institute of Justice; the Department of Energy; and the Bureau of Alcohol, Tobacco and Firearms. The MFRC is administered by Ames Laboratory and draws on the expertise of faculty and staff members at Iowa State University, IPRT, Ames Lab and other professionals throughout the region.

CATD Works to Launch More Startups

IPRT's Center for Advanced Technology Development is leading an effort that aims to create 15 technology-based businesses in Iowa over a three-year period. The Technology Commercialization Acceleration Program is a partnership between the Iowa Department of Economic Development and Iowa State University.

"Iowa is a leader in our ability to put together partnerships like this one. Our future growth depends on research and development and helping our entrepreneurs succeed," said C. J. Niles, director of the Iowa Department of Economic Development.

Through TCAP, CATD and several other ISU organizations will provide research and engineering assistance, perform market and customer research, and supply intellectual property services to Iowa entrepreneurs and businesses, according to Mark Laurenzo, CATD interim director. "This program is especially critical to Iowa's new economy," he said. "We'll be greatly increasing a startup company's chance of success."

Funding for TCAP comes from IDED's Advanced Research and Commercialization program. In addition to CATD, the other ISU organizations involved are the ISU Research Park, ISU Pappajohn Center for Entrepreneurship, ISU Research Foundation, and Office of Intellectual Property and Technology Transfer. The effort will also involve community economic development organizations, university faculty and student teams.

Ames Lab Technologies Make Top 100

Technologies developed at IPRT's Ames Laboratory are among those recognized as the U.S. Department of Energy's all-time scientific and technological achievements. The Energy 100 Awards honor the 100 best scientific and technological accomplishments since the DOE's creation in 1977.

Three Ames Laboratory research efforts were recognized on the Energy 100 Awards list. Number 24 on the top-100 list was photonic bandgap structures, which was one of only three discoveries and innovations recognized from 1990. Lead-free solder was 36th on the list; one of only two research projects recognized in 1994. Magnetic refrigeration made the 59th spot on the list and was one of 10 discoveries and innovations recognized from 1997.

Ames Laboratory's Karl Gschneidner, along with Vitalij Pecharsky and David Jiles, developed magnetic refrigeration, which was named as one of the top 100 accomplishments since the U.S. Department of Energy's creation in 1977. A prototype unit was recently demonstrated.

Ames Lab/CNDE Strive for Safer Nuclear Power

A research project proposed by IPRT's Ames Laboratory to help ensure the safety of future nuclear power systems is being awarded $940,000 funding for a three-phase project under the Nuclear Energy Research Initiative. This U.S. Department of Energy program supports innovative, investigator-initiated research and development to advance next-generation nuclear technologies. Only 13 out of 145 projects were selected to receive funding.

The Ames Lab project, On-Line Nondestructive Evaluation for Advanced Reactor Designs, received $300,000 for the first phase. Norio Nakagawa, a physicist in IPRT's Center for Nondestructive Evaluation, is leading a research team that includes R. Bruce Thompson, CNDE director; Feyzi Inanc, CNDE engineer; and collaborators from Westinghouse Electric.

"Energy sources for the future is a very timely topic, and we are excited to be working with one of our corporate sponsors to examine ways to ensure safety in the design of new energy systems," said Thompson, who also is director of Ames Laboratory's Nondestructive Evaluation Program.

CATD Boosts Iowa's Share of Federal Funds

Each year, larger federal agencies are required to set aside a specified portion of their research and development funding to assist small businesses. Traditionally, Iowa has not faired well in garnering grants from these two programs, the Small Business Innovation Research Program, or SBIR, and the Small Business Technology Transfer Program, known as STTR.

In 1994, Iowa received less than $250,000 in SBIR/STTR awards. Since 1995, however, IPRT's Center for Advanced Technology Development has been leading the effort to increase Iowa's share of these awards. Since those efforts began rolling in 1996, Iowa's SBIR/STTR awards have been more than $1 million per year, and even amounted to more than $2.5 million in 1999.

CATD is continuing its role to increase Iowa's participation in the competitive two-phase SBIR/STTR programs, which offer excellent opportunities to gain funding of up to $850,000 from the federal government for research. For 2002, the Small Business Administration renewed $80,000 in funding to support CATD's SBIR/STTR programs, which will focus especially on helping companies go after the more lucrative Phase II awards. CATD will continue to hold its twice-yearly SBIR/STTR information workshops for Iowa companies.

CSET Researchers to Turn Switchgrass into Power

Iowa farmers may soon be growing power in the form of switchgrass, thanks to research led by Robert Brown, director of IPRT's Center for Sustainable Environmental Technologies. The work is being done with the aid of a $250,000 grant from the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

The research will be conducted at the Biomass Energy Conversion facility operated by the Iowa Energy Center in Nevada, Iowa. There, a biomass gasifier will convert switchgrass, a prairie grass native to the United States, into a hydrogen-rich gas that can be converted into electric power using a fuel cell. Gasification converts solid organic materials such as biomass into a flammable gas by heating it to very high temperatures.

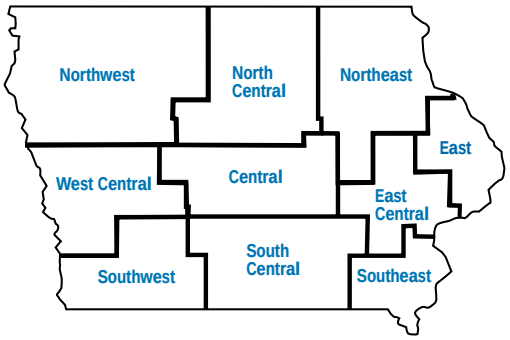
Hydrogen is an attractive fuel because it produces very low pollution emission. But, hydrogen gas rarely occurs naturally and must be produced from other resources that contain hydrogen. Hydrogen produced from biomass is particularly attractive as part of a sustainable energy future.

Normally, however, the concentration of hydrogen that results from gasification of switchgrass is very low. With support from the Iowa Energy Center, a utility rate-payer-funded organization that provides grants for energy efficiency and renewable energy research, Brown's research group developed a gasifier that dramatically increases the concentration of hydrogen in the product gas.

This fall, another $500,000 for this project was approved by the House-Senate Conference Committee on Energy and Water Appropriations. It's part of the funding for several Iowa projects that must go to the Senate and House for final approval.

Iowa Interactions
FY 2000-2001

The Institute for Physical Research and Technology assisted over 195 organizations in 87 cities and towns, covering 56 Iowa counties. This assistance ranges from initial contact and referral to full research projects. This listing is incomplete as many companies request that their contact remain confidential.



NORTHWEST

Alta
Enron Wind Corp.
Hospers
Den Hartog Industries
Ida Grove
Midwest Industries, Inc.
Laurens
Positech
Lawton
Schaeff
Orange City
Van Beek Global
Rock Valley
Valley Machining Co.
Sioux City
All Power, Inc.
City of Sioux City
Kind and Knox Gelatine, Inc.
Sioux Rubber Applicators
Sioux Tools, Inc.
SOSINC
Spencer
Maurer Manufacturing, Inc.
Tecton Industries, Inc.
Spirit Lake
Polaris Industries, Inc.

NORTH CENTRAL

Alden
Martin Marietta Aggregrates, Inc.
Allison
Allan, Inc.
Belmond
Eaton Corp.
Blairsburg
Chamness Technology
Clear Lake
Cole Sewell
Frontier Labs, Inc.
Kingland Systems Corp.
TeamQuest Corp.
Conrad
Green Products Co.
Ritchie Industries, Inc.
Ellsworth
Casual Cuts
Fort Dodge
Iowa National Guard
Josephson Manufacturing Co.
Moeller Furnace Co.
Garner
Iowa Mold Tooling Co.
Iowa Falls
Paul Zoske
Mason City
Alexander Manufacturing Co.
Bugless Limited
DSC, Inc.
IMI Cornelius
Metalcraft, Inc.
Northwood
Advanced Component Technologies, Inc.
Radcliffe
Mirenco, Inc.
Sheffield
Creative Solutions Unlimited, Inc.
Sukup Manufacturing
Shell Rock
Hobson Brothers Mold & Pattern Works
Webster City
Beam Industries
Frigidaire Co.
Land O' Lakes
Van Diest Supply Co.

NORTHEAST

Cedar Falls
Iowa Metal Spinners, Inc.
Patricia Murphy
Viking Pump, Inc.
Wayne Engineering Corp.
Cresco
Donaldson Co.
Featherlite Manufacturing, Inc.
Decorah
Bruening Rock Products, Inc.
Dewar
Fence Scape
Earlville
E.I.P. Manufacturing Inc.
Independence
Geater Machining and Manufacturing
Lansing
Alliant Energy
Oelwein
Heartland Resource Technologies, Inc.
Transco Railway Products, Inc.
Postville
Industrial Laminates/Norplex, Inc.
Vinton
Frog Legs, Inc.
Waterloo
Deere & Co.
John Deere Product Engineering Center
Omega Cabinets, LTD
West Union
Dura Automotive Testing

WEST CENTRAL

Adair
Schafer Systems, Inc.
Council Bluffs
Milco
Omaha Standard, Inc.
Harlan
BioMass Agri Products
Insul-8
Jacobs Corp.
Templeton
Paq-cell, Inc.

CENTRAL

Ames
3M Corp.
Acumen Instruments Corp.
Advanced Analytical Technologies Inc.
BioForce Laboratory
City of Ames
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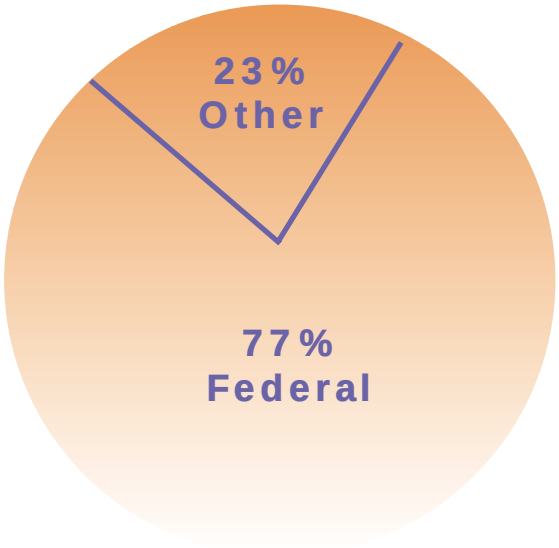

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